the ovary never ripens. The fructiferous flowers have neither calyx, corolla, nor stamens, but consist at first of a minute ovary on a rigid stipe that arises from between two bracteoles. After fecundation, the minute ovary swells, and at the same time burrows in the ground, where it ripens."

On examination, I found in some specimens that had been in flower some days, in the axils of two or three of the lower leaves, minute, sessile (sometimes two or three in a kind of one-sided raceme), conical germs situated between two bracteoles; these gradually elongated themselves, until, reaching the earth, they penetrated beyond the reach of light, where their extremities becoming etiolated they grew succulent, enlarged, and ripened their fruit. The stipe of the fruit varies much in length; in the prostrate forms of the plant from 1 to 3 or 4 inches; but in an upright variety which I cultivate, they grow 6, 12, and sometimes even 18 inches before reaching the earth, and in their growth hang around the stem like aërial rootlets. In the axils next above these fertile germs, in my specimens, I found petal-bearing flowers, which I at first (supposing Mr. Bentham's views of course to be correct) regarded as barren. But after close and repeated examinations, to my surprise I found them in all respects perfect, and what at first sight I had thought a long peduncle which withered with the flower, proved to be a slender, tubular *calyx*, through which there was no difficulty in tracing the style to a minute conical germ, situated between two bracteoles, and in all respects identical with those in the axils below; and after examining a few plants, I succeeded in finding germs elongated to two or three inches, with the marcescent calyx and corolla still *adhering to their points*, and stimulated into growth beyond a doubt by the perfect and fertilized ova. Younger plants just getting into bloom showed petal-bearing flowers in the lowest axils; and doubtless those that I first examined, and which I thought achlamydeous, would have been found so, if seen a little earlier; for, generally, the flower falls away entirely, and is seldom found attached to the germ after withering. *The flowers of the* Arachis hypogæa *are all petal-bearing and all fertile.* The plant is in some respects a singular one, and I am not surprised that Mr. Bentham, or any one else who had not watched it in all stages of its growth, should have fallen into error as regards its fructification.—*Silliman's Journal for March* 1855.

On the Structure of the Starch Granule. By Mr. Grundy.

The structure of the starch granule being by no means clearly understood, I am induced to submit the results of a few observations on the subject, with the view, if possible, of adding a little to our knowledge of its structure. There are, as is well known, two views of its constitution; one, especially advocated by Schleiden, considers it as increasing by means of layers deposited from within outwards, and that there is no membrane enveloping the granule; secondly, the view of Nägeli and others that it is a true cell, consisting of a wall and contents, the starch being deposited from without inwards. These two views have been considered completely at variance with each other. I trust, however, to be able to show, that while neither is absolutely false, neither fully accounts for all the phænomena observed in the development of starch. With regard to the first view, the balance of evidence certainly appears in favour of the exogenous, so to speak, development of starch; that is, that the starch is deposited in layers, the inner layers being formed first. As our esteemed President observed at a former Pharmaceutical Meeting, "If you examine the young tuber of the potato, you find only a few fully-formed starch grains, and numbers of small, round, incomplete grains; while in the mature tuber the reverse is the case—the majority of the starch grains are fully formed, and only a few of the small, incomplete grains are met with. If, however, the fully-formed starch be carefully examined, the inner concentric layers are found to be circular, and to present, in fact, precisely the figure and appearance of the small, undeveloped grains, leading thus to the inference that the remainder of the starch has been deposited round these small granules." Now there is no doubt that, as far as it goes, this is a true statement of fact. It appears to me, however, that it does not fully explain all the phænomena. The starch is usually free in the sap, and in those instances in which it is met with adhering to the cell-wall, I think it is only entangled in the mucilaginous protoplasm. Yet we cannot discover any proof, by the use of tests or other means, of the existence of starch, as such, in the cell-sap. Von Mohl supports this conclusion. To me it appears that starch is not at all soluble in water, nor in any state of combination as starch. But instead, we find gum and other matters in the cell-sap, of which starch may be formed, but not starch itself. I think gum, starch and sugar, members of one series, each higher in its state of organization than the other, the crude compounds absorbed by the fibrils of the root being transformed first into gum. If we adopt Schleiden's view, I do not see how we are to account for the deposit of starch. If it be a mere chemical product, it seems singular that it should only be deposited in such definite forms, and never on the cell-walls or on the chlorophyll granules which sometimes occur in the same cell with the starch.

There is, however, the view of its composition advocated by Crüger. He asserts that the primordial utricle is the source of the starch; that the starch granule first appears as a mere point, not coloured blue by iodine; and that, in all stages of the starch granule, a layer of a nitrogenous substance, coloured yellowish by iodine, covers the granule. This layer he looks upon as altered protoplasm, in the course of transition to starch. He obtained plants in which the starch grains were few in number, and in which they were imbedded in the protoplasm lining the cell. I do not see, however, how this view is to be applied in all cases; in the potato, the cells are quite filled with starch—all cannot be imbedded in the protoplasm; besides, protoplasm is nitrogenous, starch is not; protoplasm, therefore, cannot form starch in equal quantity with itself, and there certainly appears more starch in the full-grown potato cell than there ever was of protoplasm. Starch is too, I think, denser than protoplasm, which would tend to increase this difference. My own view on the subject is, that the starch granule is truly a cell, having a wall distinct from the contents. I am inclined to believe that the first formation of starch is by a small portion of the protoplasm becoming aggregated, as a nucleus, developing over itself a membrane; this membrane then commencing to secrete starch around the original nucleus; in fact, that they are produced much as the spores of some Algæ are produced, in which the protoplasm splits into many portions, each secreting itself a cellulose wall. With this addition, I take Schleiden's view of the structure of starch as entirely correct, the only point required being explained by the hypothesis of a membrane, the exact origin of the starch. Indeed, I consider the starch cell as closely analogous to the secreting epithelium cell of animal physiologists—viz. a cell which draws the materials of its growth from the surrounding fluid, and having reached the limit of its growth, dies as a cell, and becomes amenable to chemical influences. The point on which I lay most stress as proof of its cellular character, is the definite size and shape of the granule. If it be formed, as Schleiden asserts, by mere layers of deposit, I see no *à-priori* reason why this process should cease at any particular time, or why the size and shape of the exogenous starch granule should not be as indefinite and unlimited as those of an exogenous tree. A cell, however, has, under the same circumstances, a tolerably definite size and shape. The fully-formed cells of any organ in the same plant agree in the closest manner among themselves as to size and shape, however much they may differ in these respects from the cells of other organs, or from those of the same organ in other plants. This is seen in the clearest manner in undoubted free cells, as spores and pollen grains which in the same plant agree in the closest manner with each other. The cellular character of starch is obscured by the fact that the contents are at all stages solid, so that the use of the compressorium and other means usually employed to determine the cellular character of an object fail from this cause.

Now, if starch be merely a chemical product of the protoplasm, whence does it obtain the distinct definite form so characteristic of this substance? The starch granules of each plant have a certain distinctive form and appearance peculiar to themselves, by which they may be recognized under the microscope, and there are few, if any plants, the starch granules of which are precisely similar in form. Crystallization is the only means by which homogeneous substances, whether organic or inorganic, are aggregated into definite forms. No one, however, would call the starch granule a crystal. Starch, also, does not always occur solitary in cells; it occurs in company with chlorophyll, and possibly raphides. If it were formed by exogenous deposition, it seems to me very probable that occasionally one of these foreign bodies might be entangled and enclosed in the substance of the granule,—not often, perhaps only once in a thousand times; yet, as far as I am aware, no such occurrence has ever been observed.

With regard to the observed existence of a membrane, of which I have not yet spoken, the experiment of Mr. Busk, and also that of merely boiling a little starch in water, and examining the results, are, to my mind, quite conclusive. In the latter case we observe numerous thin, collapsed, vesicular-looking membranes, which do not appear to dissolve after many hours' boiling, while the true starch which these membranes enclose is extracted by the water, as is proved by its behaviour with iodine. This membrane appears to me to differ, not only in consistence, but also in chemical character, from starch, since, if iodine be added to starch which has been boiled in water, and the result examined by the microscope, the blue colour is seen to be due to amorphous masses of starch,—the membranes, when seen separate from the starch, not appearing coloured.

The coloration was produced in some cases by portions of yet adhering starch, which of course was coloured blue. This might, however, be distinguished from a true coloration of the membrane by its patchy granular appearance, and also by the colour not being thicker where wrinkles were visible in the membrane. A large quantity of iodine was required to produce any particular effect; the membranes then became of a deep brownish-red, but not blue, which certainly appears to evidence a different composition from starch. At first I was inclined to believe the enveloping membrane to differ from cellulose, not being able to produce a blue colour with iodine and sulphuric acid. I have since succeeded in producing this effect by macerating boiled starch in dilute nitric acid for several hours. Schleiden has observed that the outer layer of the starch granule behaves differently with iodine from the rest, and explains it by saying that the outer layer becomes infiltrated with foreign matters, which hinder the characteristic reaction of starch. This is in all probability correct, but it is inconsistent with his own theory. The outer membrane of the small round granules is affected precisely as that of the larger; yet, according to his views, the small granules were the nuclei, so to speak, on which the larger were to be deposited. Each layer in succession ought to be infiltrated, but evidently is not. His explanation, in fact, is an argument in favour of my view. The membrane, being always exterior, of course runs much greater chance of infiltration. I have not yet said anything of the concentric lines, my theory not being inconsistent with either of the views entertained on the subject. Although I believe in the existence of a membrane, I do not see that the lines must necessarily arise from foldings of that membrane. They may still be due to the existence of layers. Schleiden states that the concentric lines may be traced all round the granule. I have not been able to satisfy myself of this, and am inclined to believe that only the interior lines can be traced entirely round. If starch be heated on a metal plate until it turns brown, then treated with weak solution of iodine and examined, crescentically-shaped pieces appear to separate from the large end of the granule, leaving a central rounded portion, while the smaller end is not so visibly affected. Of course, according to Schleiden's view, the continuity of the lines is a necessary consequence of the formation by layers. I did not attempt to trace the continuity of each line: I endeavoured to count the number from the small end to the hilum, and from thence to the large end, and could always distinguish more lines in the latter direction. The starch certainly appears, when heated on a metal plate, to separate in the direction of the concentric lines. Also, if starch be made into a paste with gum, and thin slices be taken from the mass, many sections of the granules will be made. As far as my observations extend, if a granule from which only a small piece has been cut off be observed, cross lines upon the cut surface uniting the concentric lines will be seen. If, however, the section extend through the middle of a granule, such lines will not be observed. Also in examining uninjured starch, I fancy that, the starch (being beyond the focus) as it is brought into focus, the concentric lines come into view on the surface of the granule before the edges are quite brought into focus, as though the markings were superficial. May not the lines be formed by foldings of the membrane dipping into the starch, and disposing it to break up in the direction of the folds, somewhat analogous, in fact, to the ruminated albumen of the nutmeg? I do not positively assert this view, but merely throw it out as a conjecture; it seems to me not improbable. The hilum I believe to be the remains of the nucleus, which in full-grown vegetable cells is generally absorbed; that it is a hollow space filled possibly with amorphous starch, perhaps only with water or cell-sap. I think, however, that the only method of attaining a sure knowledge of the structure of the starch grain is by observations on its development; by taking, for instance a potato, examining by sections the first appearance of the tubers when they appear as mere swellings of a fibril, and continuing the observation up to the cells of the fully-formed tuber. I purpose making some observations on the subject during the spring, and if I find them of any value, will communicate them to the Society.—*From the Pharmaceutical Journal*, April 1855.

Description of a New Species of Aulacorhamphus. By John Gould, F.R.S.

Aulacorhamphus cæruleogularis.

Upper surface dark green, with an olive tint on the head and nape, and of a brighter green on the rump and upper tail-coverts; primaries blackish brown, margined externally at the base with dark green; tail deep green, passing into blue towards the extremity, and tipped with rich chestnut; throat and fore part of the cheeks cærulean blue; under surface green, washed with yellow on the flanks and abdomen; under tail-coverts rich chestnut; bill black, with the exception of the upper part of the sides of the upper mandible and the apical portion of the culmen, which are greenish yelllow, passing into